PAPERS READ.

Notes on the Moore Park Borings.

By James C. Cox, M.D., F.L.S., &c.

Plate XII.

The borings at Moore Park, of which the accompanying plate gives a good illustration, were commenced in May, 1879, under the able superintendence of Mr. John Coghlan. The spot selected for making the bore is situated about half-a-mile south of Baptist's Gardens, at the end of Bourke Street, Surry Hills, and is about 20 feet above the level of the sea. The drill used on this occasion was one of the Hydraulic Feed Diamond Drills, having a diameter of $2\frac{5}{8}$, and drawing a core of two inches in diameter. The boring continued uninterrupted up to the 10th April last (1880), when, at a depth of 1860 feet, operations were stopped through one of the tubes giving way, owing to a flaw in its side, at a depth of 300 feet from the surface.

In consequence of the very sandy nature of the spot selected for this experiment a stand three-inch pipe was driven for a distance of 143 feet, and at this point rock was reached. The bed of sand passed through had all the character of the ordinary drift sand of the surrounding hills, and was saturated with water, though the water did not rise higher than four feet six inches from the top of the tube. The rock first tapped was a white cellular sandstone, very soft, and, owing to the large size of the cells, easily broken. This strata of white sandstone continued for a depth of 900 feet from the point where it was first struck, only altering in density as it descended. At a depth now of 1043 feet from the surface, a ferruginous clay was tapped. This rock is known on this coast as the red iron band, the character of which is so well known that it does not require any minute notice, varying in colour according to the percentage of iron it contains. This ferruginous band was found to be 263 feet thick, carrying us to a depth of 1306 feet. The same band was struck at the

Botany borings, situated between Botany Bay and Port Hacking at a depth of 900 feet, and was 260 feet thick, showing that it has a dip of only three feet in a northerly direction in a distance of about seven miles. The same band is about 750 feet above the coal at Coal Cliff; and the coal crops out on a level with the sea. Taking 750 feet as the lower edge of this iron band above the sea at Coal Cliff, and 1306 feet as its termination at Moore Park, it is evident that it takes a considerable dip northwards. The same iron band was tapped at the Newington borings at 1100 feet; but the working of the boring was interrupted before its perforation was completed.

It is an important fact that, not only the character of the rock, but the dip which the rock takes can also be ascertained by means of these drills. The rod when gripped to be raised cannot, and is not permitted to revolve in the slightest degree, or it would become unscrewed. It is kept in one position by passing it through the jaws of the clamp, and in addition is guarded by two men to prevent its rotating. While the drill was passing from the first upper bed of white sandstone into the red ferruginous bed, a stream of extremely black water came up the shaft, having very much the appearance of coal water; and it is very much to be regretted that this dark coal-like water was not more minutely examined. The core which came from this part of the bore showed some very strong evidences of coal (see specimen), and strange to say, the length of the core was considerably less than the depth which the drill had penetrated at one or two drawings.*

Having perforated the red ferruginous band at a depth of 1306 feet, a white sandstone was tapped of a very fine grain and dense texture, which continued for a depth of 110 feet, taking us to a depth of 1416 feet. Below this, again, there were 20 feet

*It is quite possible that a core such as Coal would not stand the great friction produced by the rotation of the shaft, and would be broken up before the shaft was drawn up, thus accounting for the core often not being so long as the distance penetrated by the drill.

of a coarse green sandstone, with scales of mica dispersed through it, which will, I believe, turn out to be scales of graphite. This rock is so coarse as almost to pass into a grit. Immediately below this there were about ten feet of a very hard blue sandstone very fine and dense in the grain. For thirty feet below this, a very hard blue sandstone was found, with dark partings of black shale. These black shale partings were full of a *phylotheca* (fossil coal plants and leaves), and when broken had a very characteristic resinous fracture. Below this came a dark sandstone with broad streaks of carbonate of lime running through the core longitudinally, causing it to split; this bed was about fifteen feet thick. Below this was found a rock of only two feet in thickness, but of a very interesting character, made up of broken fragments varying greatly in colour, but, as a rule, having the character of fragments of a greenish-slaty rock.

Now for the first time below this thin band the Estheria shells showed themselves. They were found in dark shaly streaks of irregular thickness, which were found to separate this layer of rock, which was a very hard sandstone, having an exceedingly fine grain. This bed was, as I have said, composed of dark shaly streaks and sandstone partings, the sandstone preponderating throughout, and was about 30 feet thick. We have now reached a depth of 1523 feet.

It will not be uninteresting here to mention that though this shell, if shell it may be called, was first struck at Moore Park, at a depth of 1523 feet, it was not found in the core raised at Port Hacking till they had reached a depth of 2160 feet. The two cores correspond wonderfully up to a depth of 1483 feet. The Estheria bed struck at Moore Park was altogether absent at Port Hacking, but there at the depth mentioned it was found in exactly the same character of shaly rock. At Port Hacking the drill entered quite a different class of rock at the depth at which the Estheria were found at Botany, it being a conglomerate of no less than 480 feet in thickness. It is difficult to account for this great

difference. Mr. Coghlan believes that the bore at Port Hacking was over what he calls a large "crab-hole," originally a cavity which had gradually been silted up with a conglomerate material. But it is much more probable that the bore at Moore Park is over the rise, and the bore at Port Hacking over the depression of an undulation, such as supposed to exist in our coal beds.

The *Estheria* shell is nothing new to science, but its discovery is quite new to our Australian Fauna. Specimens of a fossil certainly have been found among the many valuable specimens in the collection of the late Rev. W. B. Clarke, which in all probability will turn out to be an *Estheria*, discovered at the brickworks near Botany, but they were never described by him as such, and are still so indistinct as to be doubtful in their character, at any rate, they are not this species, as they are much larger. I claim it therefore, as a new species, and call it "*Estheria Coghlani*." I have called this *Estheria* a shell, but in reality, though extremely like a bivalve, it is not one. So like however is it to a bivalve that any one might readily be excused for mistaking it for one. A good figure of it is given in "Lyell's Elements of Geology," figures 490, page 450. These bivalve-like fossils are in reality the remains of fossil *Entomostraca*, of which *Estheria* is one of the genera. Lyell states that in the Trias beds of the United States two species of the *Estheria* are in such profusion in some shaly beds as to divide them like the plates of mica in micaceous shales; that these same Virginian coal measures are composed of grit, sandstone, and shell, exactly resembling those of older date in America and Europe; and they rival, or even surpass them in the richness and thickness of the seams, one of which is in some places from 30 to 40 feet in thickness, composed of pure bituminous coal. According to the monograph of the fossil *Esthonia*, published by the Palæontographical Society of London in 1862, by T. Rupert Jones, F.G.S., there were up to that date fourteen species of fossil *Estheria* known and described—one in the Tertiary formations, one, and a distinct variety of the same, in the

Cretaceous and Wealden formations; three in the Jurassic; one, *Estheria minuta*, with its varieties in the Rhœtic stages, and the same species also in the Trias formations; three in the Permian, two in the Carboniferous, and one in the old Red Sandstone. We shall now have to add another to the Trias stages as found in New South Wales.

On the authority of Professor M'Coy and of the late Rev. W. B. Clarke, Rupert Jones states that "the Jurassic-like flora of Australia, and of Southern Africa, have been hitherto collected without affording any clear traces of the *Estheria*. In 1862 there were about twenty-two species of living *Estheria* recorded, and some of them were from Australia; and I believe there are still others to be described from Australia, or else the same species exist here as are found in other parts of the world. "Recent *Estheriæ*, says the same authority, are found in fresh, rarely in brackish water." Guided by this fact, and taking for granted that our fossils were true *Estheriæ*, and that *Estheriæ* have always had fresh-water habitats, we should suppose that the deposits in which they are found free from any appearance of having been drifted, must have been formed in rivers, lakes, or lagoons; but they are occasionally found to occur with marine shells, although they are sometimes found in strata destitute of marine fauna." Jones accounts for their association with marine evidences as being the result of "driftage, or of very rapid changes of condition such as might be brought about by the alternate occupation of a lagoon by sea and river water. Seeing too that the recent *Estheriæ* appear as it were suddenly (like the apus) in pools and ditches of rain water, and are quickly developed in tanks and ponds that are dry for even ten or eleven months in the year, it is not unlikely that pools of fresh water temporarily formed on a flat seashore may have been inhabited by *Estheriæ* destined to be quickly buried in the first wind-drift of sand, or at the return of high tides." The only part of these little shell insects, as they are designated by Latrelle, which are preserved in a fossil state,

is a shell-like coating composed of one or two pieces covering the anterior thoracic segment.

Below this last *Estheria* bed came a bed of what I consider to be a volcanic mud 20 feet thick, having no traces of either the *Estheria* or *Phylotheca* remains. The next bed perforated was a shaly sandstone, containing large numbers of the *Estheria* in its shaly partings. In one of the fractures made, an impression was found, which I believe to be that of a *Stigmaria*. In some parts of this bed there were partings of a very light stone, which contained large numbers of *Phylotheca* impressions. This character of rock continued from 1543 to 1826 feet, or 283 feet in thickness. In addition to the light stone partings above mentioned, this rock had partings in its lower portion of very dense, hard, heavy, shaly sandstone. As the drill went down, the character of the rock gradually changed. It became very dark and fine in the grain. It was while boring through this character of rock, and at this depth (1826 feet), that a jet of oil came up—or what was supposed to be a jet of oil—which lasted for ten minutes, accompanied with a loud report, caused by the escape of gas on removing the shackle from the top of the drill-rod. The probability is that a cavity in the rock, full of compressed gas, had been penetrated, and that when the shackle was unscrewed, the expansion caused the water and oily contents inside the tube above the core to be forced up, causing the appearance of a flow of oil, and the report which followed was caused by the same gaseous expansion.

From this point till the boring ceased at 1860 feet, the core which came up, 34 feet in all, was full of *Estheriæ*, forming at times a distinct parting in the core, and the usual forms of *Phylotheca* plants were also very abundant. Having reached a depth of 1860 feet, owing to a flaw in one of the tubes, the boring rod broke, leaving a portion in the bore. The broken tube was found without much difficulty, and the rod was made complete by unscrewing the broken portion and replacing it with a new one. The time lost in doing this, though very short, was sufficient

to allow the rods to become jammed by the quantity of sand or debris of the boring which was suspended in solution while the drill rods were rotating, and by a cessation of this motion the sediment settled down and jammed the rods. This was proved to be the case when an attempt was made to haul up the rods. A force of about 15 tons was employed, with large double and treble blocks, and rope of large dimensions which snapped like a thread as soon as a strain was exerted. Finding that this power was insufficient to raise the rods, one of Sir William Armstrong's powerful steam hydraulic pumps was used to force a pressure of water down the tube to remove the sediment. This proved ineffectual, owing, no doubt, to the corroding of the pipes with the wet sand, which prevented the water from passing between the tube and the borehole. So great was the pressure that, while the pump was working at the rate of 100 revolutions per minute, when the pressure must have been considerably over 1000 lbs. to the square inch, one of the tubes burst, and thus put an end to pumping operations. Another method for raising the rods was then tried, which proved so far successful that 1400 feet of rods were drawn from the hole. No doubt the whole of the 1860 feet could have been successfully extracted had not the stand piping, which had been driven through the sand for 143 feet from the surface, shifted its seat, or original position, on the hard rock to which it was first driven. The shifting of a quarter of an inch on one side would have been sufficient to permit the sand to come in, and fill the bore. I may here mention that the stand-pipe was fixed to its place on the rock by cement, which casing of cement must also have been displaced and broken before the sand could enter.

I have thus given you a hurried sketch of the strata met with in this important experiment. A minute analysis will still be required of each core of rock; and it is to be hoped that it will fall into the able hands of our Government Geologist, when we

may expect that the subject will be more scientifically handled than it has been in this slight notice.

NOTES AND EXHIBITS.

The President read extract from a letter from the Explorer, W. Teitkins, who was formerly second in command of the Expedition of Mr. Ernest Giles. Mr. Teitkins is engaged in exploring north of the Australian Bight, or Bunda Plateau, as it is now called:

"I have travelled but little since I last wrote. The country for many miles is either an uninterrupted Plain or else Mallee and Spinifex sandhills. The water I have now struck is 100 feet from the surface, and the strata passed through since I last wrote consist principally of sand gradually hardening into stone; these vary in colour. Before reaching the water there was a thin stratum of Ironstone about two inches thick, lying perfectly horizontal, as indeed do they all. The water was found in a dark coloured sand, but what quantity there is of it I cannot say, in fact, could a section of that well be placed by side of one of the low cliffs of the Leister Hills they would appear very much alike. Round the hills the ground is black in many places with small nodules of Ironstone, so much so that it has the appearance of the ground about a coal pit, and at the foot of some of the little cliffs huge Ironstone boulders are lying, having the appearance as if but yesterday they had been thrown upon the surface from above, and yet the surface is Limestone. Terraces, perhaps, rather than cliffs these might be called. It is a remarkable thing that no granite is to be found north of the Oldea Sand Range, and I have travelled everywhere in the neighbourhood, and the blacks say that the nearest granite is at Wynbring, which is 120 miles to the eastwards. I have been there, and know that granite is seen upon the surface all through the dense Mulgar scrubs, that reach